

Standard
for
MEASUREMENT OF RADIO NOISE
GENERATED BY MOTOR VEHICLES AND
AFFECTING MOBILE COMMUNICATIONS RECEIVERS
IN THE FREQUENCY RANGE
25 TO 1000 MEGACYCLES PER SECOND

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MEASUREMENT OF RADIO NOISE, GENERATED BY MOTOR VEHICLES, AND AFFECTING MOBILE COMMUNICATIONS RECEIVERS IN THE FREQUENCY RANGE 25 TO 1000 Mc/S

1. INTRODUCTION

The purpose of this Standard is to provide a uniform method of measurement of radio noise generated by a motor vehicle, which may affect the performance of mobile communications receivers in the vehicle.

2. NATURE OF THE RADIO NOISE

The radio-frequency noise generated by motor vehicle electric systems is characterized by a broad frequency spectrum, portions of which may degrade received signal intelligibility. Vehicular radio noise has been shown, experimentally, to be essentially impulsive in nature. The repetition rate of the impulses will depend upon the nature of the ignition system. A measure of the radio noise level can be obtained by a substitution method using a standard impulse noise source. The indicated radio noise level is a measure but not a complete measure, of the interference effect. The interference effect noted in mobile communications equipment for a given indicated radio noise level will vary depending upon the ignition system design.

2.1 Definitions

For the purpose of this Standard, the following terminology will apply:

2.1.1 Voltage Impulse: A voltage impulse is defined as a voltage pulse of sufficiently short duration as to exhibit a frequency spectrum of substantially uniform amplitude in the frequency range of interest. As used in this Standard the voltage impulse has a uniform frequency spectrum over the frequency range 25 to 1000 megacycles per second.

2.1.2 Spectrum Amplitude: The voltage spectrum of a pulse can be expressed as

$$V(\omega) = R(\omega) + j X(\omega) = \int_{-\infty}^{+\infty} v(t) e^{-j\omega t} dt$$

where

$$R(\omega) = \int_{-\infty}^{+\infty} v(t) \cos \omega t dt$$

$$X(\omega) = - \int_{-\infty}^{+\infty} v(t) \sin \omega t dt$$

and

$$\omega = 2\pi f$$

The spectrum then has the amplitude

$$A(\omega) = \sqrt{R^2(\omega) + X^2(\omega)}$$

and a phase characteristic

$$\phi(\omega) = \tan^{-1} \frac{X(\omega)}{R(\omega)}$$

The inverse transform can be written

$$v(t) = \frac{1}{\pi} \int_0^{\infty} A(\omega) \cos [\omega t + \phi(\omega)] d\omega \text{ for real } v(t)$$

An impulse is a function of short time duration compared with the reciprocals of all frequencies of interest. Its spectrum has an amplitude that is substantially uniform (in this frequency range), and its spectrum amplitude, $A(\omega)$ is the area under the impulse time-function and has dimensions of volt-seconds.

The spectrum amplitude is also expressible in volts per cycle-per-second as follows:

$$S(f) = \frac{1}{\pi} A(\omega) \text{ volts/(c/s)}$$

It is this form that is used as the basis for calibration of commercially available impulse generators.

2.1.3 Frequency Selective Voltmeter: A selective radio receiver, with provisions for output indication. For the purpose of this Standard, it must meet the performance characteristics described in paragraph 3.1.4.

2.1.4 Impulse Generator: A standard reference source of broadband impulse energy. For the purpose of this Standard, characteristics described in paragraph 3.1.3 must be met.

2.2 Sources of Vehicular Radio Noise

Motor-vehicle radio noise arises principally from the ignition circuits of gasoline (or similar) engine-driven vehicular equipment in which steep wavefront electric transients are generated by the high-voltage electric discharges such as occur across the distributor or spark plug gaps. A secondary, but nonetheless troublesome, source of noise is the battery charging circuit, in which electric transients are generated as a result of commutation by the charging generator and by the regulator. Other lesser sources of noise which occasionally are troublesome are the fan belt, gauges and instruments, and the generator shaft.